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ABSTRACT

Three experiments examined the comprehension effects of manipulating the spatial configuration of prose materials with readers who differed in lateral preference. In each investigation, adult readers of normal verbal facility who differed in their lateral preference patterns were presented with prose passages which varied orthographically. Thirty undergraduates were the subjects of the first experiment; 32 undergraduates participated in the second experiment; and 30 undergraduates participated in the third experiment. Subjects responded to free recall and restricted response measures. In general, the results showed that although lateral preference groups did not differ in short term memory or verbal facility, subjects with less consistently right patterns of lateral preference recalled fewer idea units. It was also found that shortened segments of text lines facilitated comprehension and recall for less consistently lateralized readers while having less effect on subjects with consistent patterns of lateralization. (Two figures and three tables of data are included, and 39 references are attached. (Author/SR)

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The Effects of Lateral Preference and Orthographic Structure On Reading Comprehension

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Running Head: Inducing Comprehension

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Abstract

Three experiments examined the comprehension effects of manipulating the spatial configuration of prose materials with readers who differed in lateral preference. In each investigation, adult readers of normal verbal facility who differed in their lateral preference patterns were presented with prose passages which varied orthographically. Subjects responded to free recall and restricted response measures. In general, the results showed that although lateral preference groups did not differ in short term memory or verbal facility, subjects with less consistently right patterns of lateral preference recalled fewer idea units. It was also found that shortened segments of text lines facilitated comprehension and recall for less consistently lateralized readers while having less effect on subjects with consistent patterns of lateralization.

People who present severe difficulties in comprehending the written word are often diagnosed as dyslexic. Although the argument for such a nosological inclusion has always relied on a rather tautological argument, this reading impairment has long been related to confused functional lateralization in the cerebral hemispheres of the brain (e.g., Jackson, 1869; Orton, 1937; Zangwill, 1962). With minor exceptions, clinical manifestations of a lack of secure hemispheric dominance for language functions is protrayed as resulting from cerebral insult or atypical development (see Corballis, 1983, for a review). Although specific localization of functions has been rejected, it is generally agreed that the left hemisphere serves more sequential, analytical and verbal functions (see Bryden, 1982). In contrast, the right hemisphere is suggested to be better prepared to consider parallel information of a spatial, manipulative nature (Bradshaw & Nettleton, 1981; Gazzaniga, 1970).

The fact that in humans the intentional performance of motor activities to one side of the midline is served by the contralateral cerebral hemisphere has led some to postulate that inconsistency in the preference for unimanual activities may be a behavioral expression of cortical confusion (e.g., Bryden, 1982; Dean, 1981, 1982, 1984). Operating under such a predilection, attempts have been made to confirm early clinical reports (Orton, 1937) of mixed lateral preference patterns which were related to severe language disturbances (e.g., Dean, 1978a; Dean, Schwartz,

& Smith, 1981; Zangwill, 1962). A review of this literature has led a number of investigators to conclude that if such a relationship between hand preference and language disturbances exists, it is slight (e.g., Beaumont & Rugg, 1978; Satz, 1976). Inconsistencies in past research which have attempted to show a greater prevalence of incomplete dominance for specific problem groups when compared to normals may well have varied as a function of the tasks chosen to infer lateral dominance (Dean, 1982).

In this regard, Dean, (1978a, 1980) and Dean, Schwartz, & Smith (1981) have offered data favoring confused lateral preference of some systems (task subsets) for many language-disabled individuals while other systems differed little from normals (Schwartz & Dean, 1978). Consistent with the findings of Schellekens, Schoten & Kalverboar (1983), each of these reports found confused lateral patterns on tasks requiring visually guided assistance of fine motor activities of the hands and arms. In general, although this was true, groups differed little when simple hand preference was used as the criterion measure.

The notion that specific reading disabilities may arise from inconsistent cerebral lateralization has received some support (see Bryden, 1982; Corballis, 1983). Based on this same reasoning, Dean (1978a, 1980) has offered a theoretical distinction between poor readers based on their patterns of lateral preference. Recently Dean (1978a, 1980) presented evidence of impaired spatial abilities and poor comprehension for readers exhibiting more confused patterns of lateral preference. In the same studies, readers with poor comprehension and low verbal facility exhibited patterns of lateral preference not significantly different than normals.

Although not concerned with reading problems from a neurological point of view, Cromer (1970) argues that comprehension disorders exhibited by readers with normal verbal facility come as the result of readers' inability to organize the visual input of prose materials in a linguistically relevant manner. Thus, the organization of text materials into phrase units was hypothesized to offer a strategy for encoding text materials to the poor comprehender with normal word recognition. Although experienced readers are better prepared to switch strategies and seem more reliant upon peripheral guidance for cues than inexperienced readers (Hochberg, 1970; Spragins, Lefton, & Fisher, 1976), Frase and his associates (Frase, 1973; Frase & Schwartz, 1979) present evidence that meaningful segmentation of words affects comprehension. These authors suggest that the disruption of word boundaries while increasing reading time has little effect on comprehension. Apparently, adult readers' perceptual span is affected by obvious spatial variables and the context in which the text is presented (e.g., Spragins, Lefton, & Fisher, 1976).

Recently, Dean (1978a) has noted that readers deficient in comprehension, relative to general verbal facility, display both impaired visual spatial abilities and inconsistent lateral preference. Arguing from a neurological perspective, Dean et al. (1981) hypothesized that the observed comprehension problems in these readers may relate to a difficulty in visual-verbal integration. Leading to spatial confusion and a difficulty in the integration of perceptual-cognitive information. Although such a notion is attractive, Zangwill and Blackemore (1972), upon examining individuals who presented symptoms of this syntactic dyslexia syndrome similar to that

described by Cromer (1970), attribute such comprehension disorders to backward scanning and regressive eye movements concomitant with bilateral cerebral functions. Under this assumption, these investigators hypothesize that anamalous preference patterns coexist with a proclivity for right-to-left scanning of textual materials.

In the present research, we were interested in how the visual-spatial organization of prose materials might interact with normal readers' lateral preference patterns. Generally, it was hypothesized that typographical manipulations of prose materials would covary with readers' patterns of unimanual preference. This position came as a result of prior research indicating problems in spatial organization concomitant with more mixed patterns of lateral dominance (e.g., Dean et al., 1981). Thus, it was thought that alterations in text materials which reduced the spatial processing (Dean, 1978a) or offered segmentation cues (after Frase & Schwartz, 1979) might well provide a comprehension aid for the mixed dominant reader.

Experiment 1 compared two variations of text construction with a more orthodox method of presentation for groups of readers who differed in their lateral preference. Specifically, a phrase segmentation methodology used successfully with low comprehenders of normal verbal facility (Cromer, 1970) and with normal readers (Frase & Schwartz, 1979) was investigated with readers who differed in degree of lateral preference. Zangwill and Blackemore's (1972) notion of anomalous scanning resulting from reversals in eye movements was investigated simultaneously for this group of readers. Moreover, it was posited that prose materials presented in a fashion which required right-to-left scanning and eye

movement reversals during reading would pose a processing disadvantage for the normal reader similar to that experienced by the mixed dominant individual if indeed such scanning difficulty existed. If a predilection for right-to-left scanning is a concomitant factor with anomalous dominance, then one would expect the less completely lateralized reader to be at an advantage when prose materials were organized in this fashion.

Experiment 1

Method

Subjects. The subjects were 30 (15 male and 15 female) undergraduates who participated for extra course credit. Learners were juniors and seniors who ranged in chronological age from 19 to 24 years of age. All subjects were considered to be normal, and none reported any special learning problems. Learners came from middle to lower middle-class backgrounds, as determined by the occupation of the family's major wage earner. Subjects who reported physical disabilities or hard signs of neurological involvement were excluded prior to subject selection. Three potential subjects reported a positive history of neurological disorders and thus were not included in this sample.

Design. Two factors, lateral preference and prose organization, were of interest in this study. These two factors were combined factorially to form a 2 lateral preference (consistently right lateralization vs. inconsistent right lateralization) X 3 prose organizaion (forward vs. backward vs. phrased) factorial design with repeated measures on the second factor. The distinction between consistent and inconsistent right lateral preference was based on the subject's position above or below the median score of the present sample on Factor II of the Laterality

Preference Schedule (Dean, 1986). This Factor composes 17 items involving visually guided fine motor activities of the arms and hands (e.g., "With which hand do you or would you use to put a penny in a bank"). Factor II was chosen because of its greater sensitivity to anomalous reading and language patterns (Dean, 1978; Dean et al., 1981) and performance on verbal dichotic listening tasks (e.g., Dean & Hua, 1982). Moreover, visually guided motor movements have been shown to be related to individual differences in "spatio-temporal " organization (e.g., Schellekens, et al., 1983). The median split allowed the assignment of 15 subjects per cell who were exposed to each of three prose organization manipulations. The mean scores resulting from the median split of Laterality Preference Schedule scores was 32.47 (SD = 4.03) for the high right consistent group and 50.73 (SD = 11.45) for the more mixed/left performance group. A chi-square analysis of the proportion of males and females in each group was not significant ($p > .05$).

Materials. The prose materials used in the study consisted of three 143-word passages written by the first author. Each passage was written in a rather concrete fashion and required little prior knowledge of the topic for comprehension of the text material. The level of vocabulary in each passage did not exceed a 12th grade reading ability. Moreover, passages were written such that they did not differ in various parts of speech (e.g., nouns, verbs, etc.). Topics covered in each passage were rather diverse and could be titled: "Health Care in the United States," "Dangers of Off Shore Drilling," and "A Political Biography." Each passage was typed single spaced on a 8½ X 11 sheet of foolscap and presented to

subjects in one of three fashions corresponding to the experimental conditions (i.e., standard, backward, or phrased). Passages in the standard condition were typed single spaced with 2.54 cm. margins and no indentation to begin the passage.

Passages presented in the backward condition were typed in a manner corresponding to the standard condition with the exception that words written in the standard format ran from right to left. Thus, the sentence "The dog sat up" would be written "up sat dog The." It was felt that this graphic alteration would simulate the process a natural right to left scanner with eye movement reversals would be exposed to in reading standard prose which flowed from left to right.

Passages presented in the phrased condition were typed single spaced in a fashion similar to that of the other conditions with the exception that one phrase was presented per typed line of text. Those units were determined by four graduate students who were asked to parse each selection independently and then agree upon a final form for each passage. In this way, the sentence, "The cow jumped over the moon." would be written as

"The cow jumped
over the moon."

Similar to Wiener and Cromer's (1967) and Frase and Schwartz's (1969) manipulation, the phrased condition was thought to impose a reading strategy used by mature readers (See Frase & Schwartz, 1979, for a review).

A two-part criterion measure was developed to test for information gleaned from each passage. Section 1 required the reader to freely recall everything remembered from the text. The following section consisted of a ten item, multiple-choice test concerning information presented in the

passage. In an effort to measure complex comprehension, questions were written using para-phrased statements from the test as outlined by Anderson (1973). Moreover, the majority of the questions were of a comprehensive nature, requiring integration and not simple verbatim recognition. In an effort to estimate the content validity of each of the three multiple-choice tests, four undergraduates were provided with a copy of each of the three multiple-choice tests and the corresponding passages written in the standard fashion. These subjects were asked to base their test responses on the material contained in the passage. Across tests, the proportion of correct responses (.97) indicated that multiple-choice items could be correctly answered from the passages. Proportions of correct responses for the three tests were not significantly different ($p > .05$). In an effort to discount the possibility that items could be answered without knowledge of the passage, four additional undergraduates were given the tests for each of the three passages and asked to respond to them without the passage. The results of this norming procedure showed that without knowledge of the passage, subjects could not answer items correctly above that which would be expected by chance alone (i.e., four choices = .25% correct). One point was awarded for each correct multiple-choice item.

The scoring of free recall protocol was accomplished by comparing them with a list of pre-established "idea units." The established idea units used were the result of parsing each passage into its component ideas. Basically, an idea unit was defined as a single complete idea which consisted of a sentence, clause, or phrase. This procedure of defining units of comprehension was similar to that discussed by Johnson (1970) and

used extensively by other researchers (e.g., Dean & Kulhavy, 1981; Royer & Cable, 1976). After some alterations in the passages, four graduate assistants agreed on 27 idea units for each passage. A subject's score was the total number of correctly recalled idea units for a given passage. Variations from the established list of ideas were allowed in syntax, but not in substance. All protocols were scored by one person naive to the purpose of the experiment, and errors in spelling and grammar were not penalized. Ten protocols were randomly chosen from each group and blindly rescored by another graduate assistant. For this subset of protocols, an estimate of the interrater agreement was found to be .89. Hence, the scoring of recall protocol seemed to be a reasonably consistent procedure.

Subjects' lateral preference patterns were inferred using Factor II of the Laterality Preference Schedule. Viewing lateral preference on a continuum from entirely right to entirely left, the LPS is a 49-item, self-report measure which queries respondents' preference for a number of unimanual tasks involving the hands, arms, legs, feet, ears, and eyes. In each case, respondents indicate their preference on a five-point Likert scale. Six salient dimensions of the Laterality Preference Schedule have been isolated on the basis of factor analysis. Rotating factors to a final solution using Kaiser's varimax procedure has produced a six-factor solution accounting for some 92% of the total variance (Dean, 1980; Dean, 1982). Questions on the LPS were constructed to be read with ease by an individual with a fourth grade reading ability, thus undergraduates should experience little difficulty comprehending individual items.

With prior research showing a relatively stronger relationship between Factor II (17 items involving visually guided fine motor activities of the

arms and hands) and a number of language disorders (e.g., Dean, 1978a; Dean, 1980; Dean, et al., 1981), this factor was chosen as the basis for establishing high right and low right consistent laterality groups. With this in mind, the distinction between high and low was based on the subject's position above or below the median score on this factor. Recently, Dean (1982) has reported a correlation of .93 between initial scores on Factor II and a retest a week later. Moreover, scores on Factor II have been shown to correlate significantly (r = .49, p < .05) higher with performance on a dichotic listening task than other factors (Dean & Hua, 1982).

Subjects' verbal facility was inferred on the basis of scores on the Wide Range Vocabulary Test (WRVT) (French, Ekstrom, & Price, 1963). This measure was administered as a control for a competing hypothesis that groups formed on the basis of laterality would differ in their general verbal capacity. The WRVT has been shown to be clinically useful in estimating an individual's overall verbal ability (e.g., Dean & Kulhavy, 1978). Analysis of scores for the high right consistent group ($\bar{X}$ = 27.93, SD = 7.77) and the low consistent group ($\bar{X}$ = 24.53, SD = 5.48) showed they did not differ significantly (p > .05).

Procedures. The entire experiment was conducted in a single session, and subjects were tested either individually or in groups which ranged in size from 3-15 members. After subjects were seated in the experimental room, they were given a randomly numbered envelope. Each packet contained the materials for the entire experiment and consisted of experimental booklets (containing condition specific instructions, passages, and test

materials), the Laterality Preference Schedule and the Wide Range Vocabulary Test.

Subjects were told to read instructions on the cover sheet of the experimental booklet, and to replace the Laterality Preference Schedule and Wide Range Vocabulary Test in the envelope. The written instructions requested that subjects read the passage carefully because they would be tested on its content later.

Test booklets were constructed such that the order in which conditions occurred (forward, backward, and phrased) and the specific passage used were counterbalanced. Thus, although subjects were exposed to the same three passages, the order of passages and form of presentation were varied to reduce the possibility of order and/or passage specific effects.

After being instructed to turn the cover page, learners were allowed 2.5 minutes to read and study the passage. The choice of time was based on a norming procedure which showed undergraduates could read each of these passages in two minutes or less, and times for passages were not different. After the prescribed time period, all subjects were instructed to stop reading and turn to the next page in their booklet. This page presented an interpolated mathematics task which subjects were given to reduce short term memory effects. After one minute, time was called; and, subjects were instructed to turn the page and complete the free-recall measure and passage specific, multiple-choice test. Instructions were given not to turn to other pages in the booklet. One of two research assistants monitored subjects' compliance with these instructions.

The above procedures were followed twice more so that each subject was presented with all three passages. Upon completion of the experimental

booklet, subjects were asked to remove copies of the Wide Range Vocabulary Test and Laterality Preference Schedule from their envelopes and replace them with the experimental booklets. After general instructions were read for the completion of each measure and procedural questions answered, subjects were allowed to complete the remainder of the tasks at their own pace.

Results

Each subject's protocol was scored for the number of idea units recalled from each passage, as outlined above. These data were entered into a 2 laterality factor (high right consistent vs. low right consistent) X 3 prose organization (forward vs. backward vs. phrased) analysis of variance with repeated measures on the 2nd factor. The resulting mean number of ideas correctly recalled and standard deviations are presented by condition for each group in Table 1.

The results of this analysis indicated that across conditions, the right preference group recalled significantly more idea units than the more bilateral group, F (1, 28) = 8.63, $p < .01$. As predicted, the interaction of laterality groups by conditions was also significant, F (2, 56) = 3.31, $p < .05$. The zero order correlation between Factor II of the LPS and idea units was -.68.

Insert Table 1 about here

Figure 1 graphically displays the means constituting this interaction. It is obvious from this portrayal that highly consistent right lateralized subjects comprehended more content than the low

consistent group under each condition with the exception of when material

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Insert Figure 1 about here

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was presented in individual phrases. Moreover, it seems that the presentation of text materials by individual phrases served to increase that which bilateral readers comprehended and recalled. Further, the presentation of prose in a backward fashion appears to have had a greater interfering effect on bilateral subjects. Orthogonal contrasts verified the significance ($p < .05$) of these visual interpretations.

Data resulting from the multiple-choice tests for each passage were analyzed next. Protocols were scored in the fashion previously described, and the resulting data were entered into the same 2 X 3 ANOVA model. The mean number of items correct and standard deviations are also presented in Table 1 for each condition by group.

Similar to the findings with idea units, the results of the analysis when multiple-choice items served as the dependent measure showed a reliable main effect for lateral preference groups, F (1, 28) = 10.65, $p < .01$. Again, more strongly right lateralized subjects were found to be superior to their more mixed lateralized cohorts across all conditions. Unlike the results with idea units, neither the main effect for prose organization or the condition X laterality group interaction reached conventional levels of significance. The overall zero order correlation of multiple choice items and the LPS Factor II was -.53.

Experiment 2

Experiment 1 suggested that prose recall is facilitated for the bilateral readers when text materials are presented by individual phrase units. Although the phrasing of text materials has been interpreted as a linguistic manipulation (e.g., Cromer, 1970; Frase & Schwartz, 1979; Wiener & Cromer, 1967), such an alteration also represents a rather distinct visual-spatial deviation from a standard prose presentation. Thus, the extent to which these results were a function of linguistic organization or a revision in the visual spatial configuration is not clear.

The second experiment examined critical factors involved in the facilitation effects for pre-established linguistic units. Basically, the strategy employed in this experiment involved manipulating the degree to which shortened prose strings were based on linguistic units. Although text material presented by linguistic units may have provided a comprehension strategy, this change in the text also reflects quite a distinct alteration in the amount of visual-verbal material the reader was required to process at one time. The results of the first experiment could also be attributed to a short-term memory aid which reduced the number of words the reader needed to remember prior to instantiation (Anderson, 1970) of the text material.

Method

Design and subjects. Two factors, lateral preference and prose organization, were of interest in this experiment. The subjects were 32 (16 male and 16 female) undergraduates who were assigned in a post hoc fashion to high right consistent and low right consistent lateralization

groups on the basis of their Laterality Preference Schedule score above or below the median of those tested in Experiment 2. Chi-square analysis showed the proportion of males and females in each group was not significantly different. As in experiment one, potential volunteers with learning problems, physical disabilities, or hard signs of neurological involvement were excluded prior to subject selection. Within each laterality group, subjects received prose materials in both a phrased and a short-line fashion. The design was thus a 2 laterality group (high right consistent vs.low right consistent) X 2 prose presentation (phrased vs. non-phrased) factorial design with repeated measures on the second factor.

Materials. Two of the passages used in Experiment 1 were randomly chosen to be used in this study. Specifically, the passage concerning health services and the dangers of off-shore drilling were utilized. Each of these passages was typed single spaced on a single sheet of foolscap in either a phrased or non-phrased fashion. Text materials presented in a phrase-by-phrase manner were identical to those used in Experiment 1. When text materials were presented in the short-line fashion, typed lines were both left and right justified, such that each line of text was approximately 5.1 centimeters in length. The mean line length for passages presented in the phrased fashion was 5.8 (SD = 2.04) centimeters.

The two-part criterion measure used in Experiment 2 was identical to that used in the first experiment, with the exception that distractors and correct responses of the multiple choice items were eliminated. The ten item stems of the former multiple-choice test were retained as

constructed response items. This manipulation was thought to reduce what was seen as a rather restricted measure of comprehension offered by the multiple-choice tests in Experiment 1. This short-answer test for each passage was graded on the basis of specific scoring rules. That is, variations from the Keyed responses were allowed in syntax but not substance; correct responses werre awarded 1 point. Scoring of the free-recall measure was accomplished using the procedure established in Experiment 1.

As was true in Experiment 1, lateral preference patterns were inferred using Factor II of the Laterality Preference Schedule. After ordering scores on this factor, a median split was used to form high right consistent and low right consistent groups of subjects. Information concerning subjects' verbal facility was again collected using the Wide Range Vocabulry Test. Post hoc analyses of scores on this measure again showed that laterality groups did not differ significantly on this variable ($p > .05$).

Readers' short-term memory was inferred on the basis of an adapted form of the Digit Span subtest of the Wechsler Adult Intelligence Scale ((Wechsler, 1955). The digits forward portion (Trail 1) of this measure was administered in a group fashion, and subjects responded by writing the digits remembered on an answer sheet provided in their experimental booklet. Subjects' protocols were scored for the total number of digits written in the correct sequence.

Procedure. This experiment was conducted in a single session. Subjects participated either individually or in groups which ranged from 2-9 members. Subjects were seated in the experimental room and were

randomly assigned numbered envelopes containing all experimental materials. Each envelope contained an experimental booklet, copies of the Laterality Preference Schedule, and Wide Range Vocabulary Test. The same general instructions provided subjects in Experiment 1 were read, and procedural questions were answered.

Subjects were instructed to read the cover sheet of the experimental booklet carefully and replace other materials in their envelopes. As was true in Experiment 1, test booklets were constructed such that passages and condition of presentation were counterbalanced across laterality groups. Therefore, while each subject was exposed to both passagaes, the order and form of presentation were varied systematically.

Next, the forward digits of the WAIS were presented to the group, and they were instructed to write all the digits they remembered when the command to "write" was given after the presentation of each digit string. A research assistant was present to monitor subjects' compliance with the instructions. The resulting protocols were scored for the total number of forward digits recalled in the sequence in which they were presented.

The remaining procedures for this experiment were identical to those of the first study, with the exception that only two passages and corresponding criterion measures were presented. Thus, the read, interpolated task, criterion measures order was followed again and timed in the same fashion.

Results

Each subject's protocol was scored for the total number of idea units recalled from each passage. Table 2 presents the resulting means and

standard deviations for each group by condition. Next, these data were entered into a 2 laterality group (high vs. low right) X 2 prose

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Insert Table 2 about here

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organization (phrased vs. short line) analysis of variance with repeated measures on the second factor. Neither main effect or the laterality group X prose organization interaction reached conventional levels of significance ($p > .05$). Similar to the findings for phrase presentation in Experiment 1, groups did not differ in comprehension and passage recall. The present data also indicate little difference between laterality groups either for phrased presentations or for text presented in lines shortened in length.

Subjects' constructed response protocol were scored in the fashion outlined above. The mean number of corrects and corresponding standard deviations are displayed in Table 2. These data were entered into the same ANOVA modal used to analyze idea units. Similar to the results found with idea units, neither the main effect for laterality groups or the group by condition interaction were significant ($p > .05$). Therefore, whether prose was written in a phrased or a shortened-line manner seemed to matter little across groups.

Finally, the raw scores resulting from the digit span subtest were analyzed by laterality groups. The results of this analysis showed that the mean number of digits recalled for the consistently right lateralized group ($\bar{X} = 29.06$, $SD = 3.25$) was not significantly ($p > .05$) different than that of the low right consistent group ($\bar{X} = 28.81$, $SD = 2.73$).

Experiment 3

The general finding of the second experiment indicated that consistently right lateralized readers and their more bilateral cohorts differed little in short-term memory or in prose comprehension when textual materials were presented in a shortened fashion. This was true when the shortened text was based on linguistic units or merely on the length of the prose word string.

In Experiment 3, we examined the extent to which variations in the length of word strings in prose presentaiton would interact with the reader's lateral preference patterns on measures of recall. Thus, it was reasoned that spatial configuration of the prose word string may well serve as a crucial variable in text processing for the bilateral reader.

Method

Design and subjects. Both lateral preference and length of prose presentation were of interest in this experiment. The subjects were 30 (15 male and 15 female) undergraduate volunteers who were assigned to a high right consistent or low right consistent laterality group based on whether their Lateriality Preference Schedule score fell above or below the median on Factor II. Each prose passage presentation was varied in length. These factors were combined factorially into a 2 laterality group (high right consistent vs. low right consistent) X 3 prose length (short vs. midrange vs. standard) design with the last factor being varied within each group. Laterality group means for verbal facility and the

proportion of males and females in each group did not reach conventional levels of significance. None of the subjects indicated having learning problems, and potential volunteers reporting physical disabilities or neurological involvement were screened from selection.

Materials. The prose materials used were the same as those described in Experiment 1. Each passage was typed single spaced on a sheet of foolscap. Text materials were prepared in three different fashions which varied in the length of typed lines. The versions were as follows: standard line = 16.51 cm., reduced line = 10.16 cm., and short = 5.11 cm. Thus, the shortened version of each passage was the same as the materials used in the non-phrased condition of Experiment 2. Passage order and conditions were counterbalanced across groups.

The dependent measures were similar to those used in the prior experiments. The constructed response format described in Experiment 2 was retained.

Similar to the prior experiments, relevant information concerning subjects' verbal facility and laterality preference were collected.

Procedures. Fundamentally, the same experimental procedures were used in this study. This included the instructions read to subjects and the presentation and timing of conditions. Grading of the free-recall protocols and constructed response items were scored using rules established in Experiments 1 and 2.

Results

The group means and standard deviaitons for idea units recalled are presented in Table 3. These data were entered into a 2 laterality group

(high vs. low right consistent X prose length (short vs. mid-range vs. standard) analysis of variance, with the last factor being treated as a within-subjects variable. The results of this analysis showed that individuals in the high right lateralized group recalled significantly more content ideas than low right consistent subjects across conditions, F (1, 28) = 8.11, $p < .01$. Although main effect for conditions was not significant, the groups by conditions interaction was, F (2, 56) = 3.87, $p < .05$.

Insert Table 3 about here

Figure 2 displays the means contributing to this significant interaction. Orthogonal contrasts of these means indicated that although the length of the prose had little significant effect on the more consistent right lateralized group, shortened prose versions significantly

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Insert Figure 2 about here

($p < .05$) increased recall of the bilateral group to the point where recall was not significantly ($p < .05$) different than that of the consistently right oriented group.

Table 3 also presents the means and standard deviations for the constructed response test by treatment condition. Analysis of these data indicated a clear superiority in the number of correct responses for the

more highly lateralized groups across type of prose segments, F (2, 56) = 3.78, $p < .05$. Orthogonal contrasts between these means showed again that although laterality groups differed in correct responses in the standard prose version, groups did not differ significantly when prose were presented in the shortened fashion.

General Discussion

The present data replicate that of Dean (1978, 1980) and Dean, et al. (1981) which show that students possessing normal verbal facility but deficits in reading comprehension present with less consistent right patterns of lateral preference. Indeed, when connected discourse was presented in a regular fashion, bilateral readers were inferior to lateralized readers on subsequent measures of recall and recognition. Interestingly, this problem in comprehension did not appear related to problems in short-term memory or verbal ability. Indeed, although laterality groups did not differ on these variables, low right consistent readers recalled fewer prose segments when they were presented in a standard fashion. These findings are accentuated by the fact that none of the readers in the present series of experiments reported having reading or learning problems. Such a finding supports a hypothesis of lateral preference differences regardless of whether subjects are diagnosed as part of an unadjusted nosological category. Therefore, one may speculate that comprehension problems related to mixed laterality preference patterns may be more heuristically represented on a continuum rather than as discrete diagnostic entities. It is of interest to note that although past research has shown many poor comprehenders to present

more anomalous patterns of preference on various systems of laterality (Dean, 1978; 1980; Dean et al., 1981), when the Laterality Preference Schedule scores for subjects in the present investigation were summed across all six factors, no significant difference was found for high right consistent and low right consistent groups. This result seems to support the heuristic value of conceptualizing lateral preference as separate interacting lateral systems (see Dean, 1982, for a review).

One important finding in the present research involved the interaction for free recall but not for more structured measures of comprehension. These data seem important in light of the extent in which a multiple-choice format is used to infer reading comprehension in prior investigations. More importantly perhaps, such a restructured response test mode is used extensively in the classroom, whereas free-recall paradigms are rarely employed as measures of comprehension. Dean and Kulhavy (1981) argued that such results stem from the fact that multiple-choice and short-answer tests restrict comprehension to comparatively few prose segments; whereas, a free-recall format seems to allow the reader to display comprehension of a wider range of information contained in the passage. It also seems that for the more firmly right lateralized reader, the response mode of the criterion measure is less important. A comparison of the results from Experiment 1 and 3 seems to indicate that a constructed-response format may also decrease the restrictions of multiple-choice items.

The most striking finding of the present group of experiments is that alterations in the segmentation of connected discourse facilitate

the comprehension and recall for readers with less consistent lateralized patterns. The combined results of Experiments 2 and 3 suggest that the shortening of text lines on the basis of linguistic rules was not the locus of the facilitative effect, but rather that the actual visual span of the text was the salient variable. Indeed, it would seem that the preorganization of word groups (Ex. 2) mattered less than the absolute length of the segment (Ex. 3). These results appear to run counter to Frase and Schwartz's (1979) findings of increased reaction time for nonmeaningful segmentation and Anglin and Miller's (1968) reported recall facilitation for intact phrases. As meaningful segmentation and segmentation based on the length of prose word string had little effect on recall in Experiment 2, one may question the extent to which phrase boundaries occurred by chance in segments based on length alone. This question is of interest because the probability of a phrase boundary occurring at the end of a prose segment by change would seem to increase as lines shortened. In an effort to examine the chance phrasing, the standard line, reduced line, and short line, versions of each passage were compared with the corresponding phrased text. Across specific passages, standard line (.13), reduced line (.15), and shortened line (.20) presentations were not significantly ($p > .05$) different in the proportion of segments which ended in a phrase boundary. When the proportion of phrase boundaries perturbed by one word or less was examined this trend was significant. Moreover, this analysis showed the proportion of one-word perturbed boundaries in the short line (.33) version to be significantly ($p < .05$) larger than the

reduced line version (1.18) or that of the standard format (.15). Thus, it would seem that segment line length in the short-line version may have not disrupted the spatial cue necessary to cause a switch in strategy from large unit processing to word by word. As Spragins, Lefton, and Fisher (1976) have suggested, although adult readers are highly dependent upon peripheral cues, contextual information may compensate for all but highly perturbed boundaries. This appears to be the case, for Carver (1970) and Anglin and Miller (1968) report that text presented in segments which approximate phrases leads to both faster reading time and higher recall.

Apparently, then, the presentation of prose in a short-line fashion, which may approximate meaningful segmentation, differentially facilitates the comprehension and subsequent recall for readers who present less consistent right of midline patterns of lateral preference. More consistently lateralized readers seem less test-bound in their acquisition. A large corpus of literature indicates that experienced readers are better able to switch strategies from larger to smaller units with spatial cues (e.g., Cromer, 1970; Fisher, 1975; Hochberg, 1970; Spragins et al., 1976). It is clear from the present data whether the less consistently lateralized individual finds it difficult to integrate peripheral and cognitive search guidance mechanisms (after Hochberg, 1970) or is deficient in the phrasing strategy which most mature reading involves (e.g., Frase & Schwartz, 1979).

Recent data indicate that language-disabled individuals who present more inconsistent patterns of lateral preference are also deficient in spatial abilities (e.g., Dean et al., 1981). Consistent with Beaumont and Rugg's (1978) refinement of Pizzamiglio's (1974) hypothesis of functional

disassociation, the less consistently lateralized reader in the present investigations may have exhibited problems in the integration of peripheral and verbal/cognitive searches. Thus, phrase segmentation may well reduce the perceptual-cognitive interaction necessary as the learner attempts to parse the text into meaningful clauses (Frase & Schwartz, 1979). In other words, the translation of visually presented stimuli into cognitively relevant components may not be a continuous process for the bilateral reader because of unconventional lateralization. Thus, the comprehension necessary for encoding may be facilitated by increasing spatial cues which approximate the segmentation strategy employed by the normal, mature reader. The research of Wiener and Cromer (1967) and Cromer (1970) would suggest that inserted blank spaces or pause markings may serve the same end as vertically presented prose segments. This manipulation remains to be investigated with the inconsistent lateralized reader, but recent data showing deficient visual-spatial abilities for mixed lateralized individuals would lead one to argue for similar facilitation (Dean et al., 1981). So too, in light of the present findings, a further examination of the neuropsychological processes exhibited by the mixed lateralized reader would appear to be a fruitful line to pursue in defining the underlying process.

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Table 1

Means and Standard Deviations for Each

Criterion Measure by Groups and Conditions

(Experiment 1)

Laterality Group		Criterion Measure					
		Idea Units [a] Prose Organization			Multiple-Choice [b] Prose Organization		
		Forward	Backward	Phrased	Forward	Backward	Phrased
Low Right Consistent							
	M	5.20	3.67	6.60	6.13	5.80	6.47
	SD	2.31	2.95	2.26	2.15	2.14	2.31
High Right Consistent							
	M	7.20	6.00	6.87	7.93	7.33	6.53
	SD	2.65	2.27	2.39	2.28	1.84	1.77

[a] maximum = 27

[b] maximum = 10

Table 2

Means and Standard Deviations for Each

Criterion Measure by Groups and Conditions

(Experiment 2)

Laterality Group		Criterion Measure: Idea Units [a] Prose Organization: Phrased	Idea Units [a] Prose Organization: Short Line	Constructed Response [b] Prose Organization: Phrased	Constructed Response [b] Prose Organization: Short Line
Low Right Consistent					
	$\bar{x}$	7.69	7.34	6.81	6.75
	SD	2.70	2.34	1.94	1.69
High Right Consistent					
	$\bar{x}$	7.38	8.72	6.41	6.22
	SD	3.79	3.11	1.82	2.02

[a] maximum = 27

[b] maximum = 10

Table 3

Means and Standard Deviations for Each

Criterion Measure by Groups and Conditions

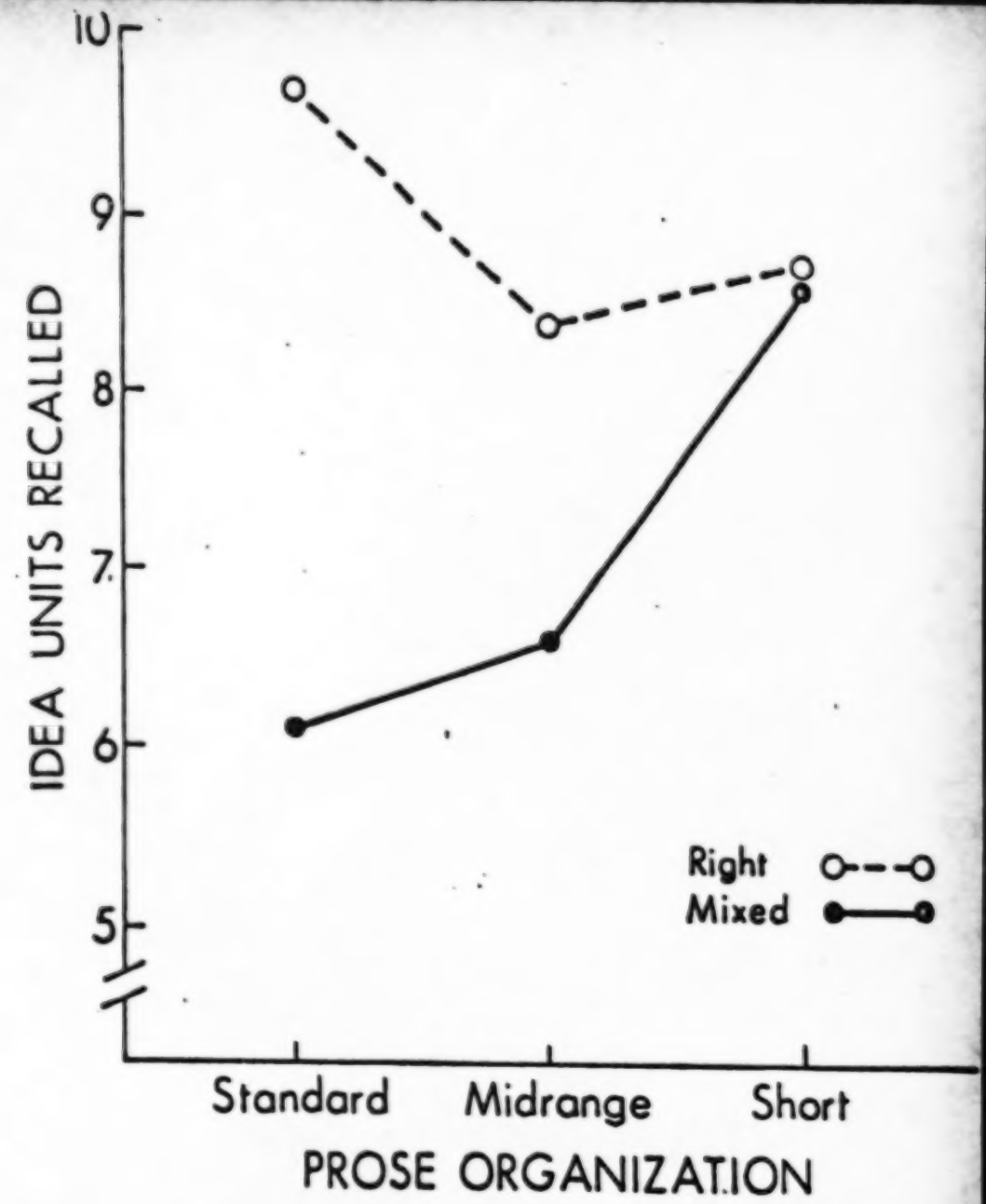
(Experiment 3)

Laterality Group		Criterion Measure: Idea Units [a] Prose Organization			Criterion Measure: Constructed Response [b] Prose Organization		
		Standard	Midrange	Short	Standard	Midrange	Short
Low Right Consistent							
	M	6.13	6.67	8.57	5.37	5.97	6.13
	SD	1.78	2.29	3.71	2.52	2.13	1.85
High Right Consistent							
	M	9.73	8.47	8.67	8.20	7.20	7.07
	SD	2.52	2.92	2.32	1.08	2.21	1.53

[a] maximum = 27

[b] maximum = 10

8
7
6
5
4
3
IDEA UNITS RECALLED
Right
Mixed
Forward
Backward
Phrased
PROSE ORGANIZATION


10
9
8
7
6
5
IDEA UNITS RECALLED
Right
Mixed
Standard
Midrange
Short
PROSE ORGANIZATION